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(54) **BIOCOMPOSITE AND/OR BIOMATERIAL WITH SUNFLOWER SEED SHELLS/HUSKS**

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CPC C08L 99/00
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(57) **ABSTRACT**

The invention relates to a biomaterial and/or a biocomposite based on sunflower seed shells/husks. According to the invention, it is proposed that sunflower seed shells/husks are used instead of wood, bamboo or other wood-like fiber products as the original material for the biocomposite products and are used for the production of such products in order to improve the previous biomaterials, and in particular also to design said materials for improved cost efficiency and to improve their material properties.

36 Claims, No Drawings

BIOCOMPOSITE AND/OR BIOMATERIAL WITH SUNFLOWER SEED SHELLS/HUSKS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a U.S. National Stage application of PCT/EP2012/070348, filed Oct. 12, 2012, which claims the benefit of priority to German Patent Application Nos. DE 10 2011 086 319.2, filed Nov. 14, 2011 and DE 10 2012 209 482.2, filed Jun. 5, 2012, which are incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

The invention relates to a biocomposite or a biomaterial. These biomaterials or biocomposites are already known by way of example as "wood-plastic composites" (abbreviated to "WPC"), i.e. wood-plastic composite materials. Other terms used for these are "wood(-fiber) polymer composites" and "wood-polymer materials". The abovementioned biomaterials are thermoplastically processable composite materials which are produced from various proportions of wood—typically wood flour—plastics, and additives. They are mostly processed by modern processes of plastics technology, for example extrusion, injection molding, rotomolding, or by means of press techniques, or else by the thermoforming process.

BACKGROUND OF THE INVENTION

Processing for WPCs is known to involve not only wood (in particular wood flour) but also other vegetable fibers, for example kenaf, jute, or flax.

The present invention aims to improve the WPCs known hitherto, i.e. the natural-fiber-reinforced plastics known hitherto, and in particular to reduce costs for the starting materials in the production thereof.

In the WPCs known hitherto, the proportion of wood is regularly above 20%, and there are therefore by way of example known WPCs in which the proportion of wood fiber or of wood flour is from 50 to 90%, these materials being embedded in a plastics matrix made of polypropylene (PP) or less frequently of polyethylene (PE). Because the wood is sensitive to heat, the only possible processing temperatures are below 200° C. At higher temperatures the wood suffers thermal changes and decomposition, and this alters the overall properties of the material undesirably.

Additives are also added in the natural-fiber-reinforced plastics known hitherto, in order to optimize specific properties of the materials. Examples of these properties of the materials are the bonding between wood and plastic, flowability, fire protection, coloring and, particularly for external applications, also resistance to weathering, to UV, and to pests.

It is also already known that a WPC can be produced by using a mixture of 50% of polyvinyl chloride (PVC) and 50% of wood fibers. WPCs of this type based on thermoplastically processable thermosets, such as modified melamine resin, are likewise under development, as is also the processing of products similar to wood, such as bamboo, the term used for these then being "bamboo-plastic composites" ("BPCs"). The classification "BPC" is used for WPCs where bamboo fibers have replaced wood fibers.

The advantages of the biomaterials described over traditional wood-based materials such as particle board or plywood are the unrestricted, three-dimensional moldability of

the material and greater resistance to moisture. In comparison with solid plastics, WPCs offer greater stiffness and a markedly smaller coefficient of thermal expansion. The biomaterials available hitherto also have the disadvantage of lower breaking strength than sawn timber; moldings with inserted reinforcement have greater breaking strength than solid moldings and sawn timber. The water absorption of moldings with no final coating is higher than that of solid plastics moldings or moldings with film coating or with flowable coating.

It is known that the biomaterials described hitherto can be used as decking or for the production of boards, and it is equally known that WPC can be used particularly in the construction industry, the automobile industry and furniture industry, the outdoor sector for floorcoverings (patios, swimming pools, etc.), facades, and furniture, in particular as replacement for timber from tropical regions. There are also many known seating and shelving systems made of WPCs. Other applications are writing implements, containers, and household equipment, and WPC biomaterials are used in the engineering sector as profiles for electrical insulation, and in the automobile industry in particular as interior door cladding and parcel shelves.

It is noted that citation or identification of any document in this application is not an admission that such document is available as prior art to the present invention.

It is noted that in this disclosure and particularly in the claims and/or paragraphs, terms such as "comprises", "comprised", "comprising" and the like can have the meaning attributed to it in U.S. Patent law; e.g., they can mean "includes", "included", "including", and the like; and that terms such as "consisting essentially of" and "consists essentially of" have the meaning ascribed to them in U.S. Patent law, e.g., they allow for elements not explicitly recited, but exclude elements that are found in the prior art or that affect a basic or novel characteristic of the invention.

It is further noted that the invention does not intend to encompass within the scope of the invention any previously disclosed product, process of making the product or method of using the product, which meets the written description and enablement requirements of the USPTO (35 U.S.C. 112, first paragraph) or the EPO (Article 83 of the EPC), such that applicant(s) reserve the right to disclaim, and hereby disclose a disclaimer of, any previously described product, method of making the product, or process of using the product.

SUMMARY OF THE INVENTION

It is now an object of the invention to improve the WPC biomaterials available hitherto, and in particular to make these less expensive, and to improve the properties of these materials.

The invention proposes a biomaterial with the feature as claimed in claim **1**. The dependent claims describe advantageous embodiments.

DETAILED DESCRIPTION OF EMBODIMENTS

It is to be understood that the descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention, while eliminating, for purposes of clarity, many other elements which are conventional in this art. Those of ordinary skill in the art will recognize that other elements are desirable for implementing the present invention. However, because such elements are well known in the art, and because they do not facilitate a better understanding of the present invention, a discussion of such elements is not provided herein.

The present invention will now be described in detail on the basis of exemplary embodiments.

The invention proposes use of sunflower seed shells/husks instead of wood, bamboo, or other fiber products similar to wood as starting material for WPC products, and for the production of products of this type.

Sunflowers are cultivated in all regions worldwide, and the main objective of sunflower production is to obtain sunflower seeds and in particular the contents thereof. Before the seeds are processed, the sunflower seed has to be shelled, and this means that the actual sunflower seed is freed from its shell/husk. Large quantities of said shells/husks are produced during sunflower seed production, and are a type of waste product of sunflower seed production that can also be used for other purposes, for example as animal feed, in biogas plants, etc.

The first advantage of sunflower seed shells/husks is not only that large quantities thereof are produced but also that they are intrinsically relatively small and therefore require only a small amount of further processing, such as comminution, in order to form the starting product for an "SPC" ("sunflower-plastic composite"). The energy cost associated with the comminution or grinding of sunflower seed shells/husks is markedly lower than that for the production of wood flour for WPC production.

Another particular advantage of the use of sunflower seed shells is that these are very suitable for use for an SPC which serves for the production of packaging, for example a bottle or jar, in particular of food packaging.

However, a first trial has shown in particular that comminuted or ground sunflower seed shells/husks have excellent suitability for processing in the form of SPC and can therefore produce excellent food packaging which in no way causes any disadvantageous or other alteration to the taste of the food that is stored.

The invention therefore also represents a very sustainable approach to conservation of resources in production of packaging material or the like.

The processing of the comminuted or ground sunflower seed husks can advantageously proceed in the same way as the production of wood-plastic composites.

The proportion of the sunflower seed husks here can be from 50 to 90% of the final product, and particular preference is given to a polypropylene material as plastics matrix, but it is also possible to use a polyethylene material or polyvinyl material, although the latter appears to be less suitable.

The heat-sensitivity of sunflower seed husks (sunflower shells) certainly permits processing thereof at processing temperatures of up to 200° C., and temperatures of up to 210° C. to 240° C., preferably 230° C., are also possible; at higher temperatures, thermal changes or decomposition could occur.

Additives are added to optimize specific properties of the materials, for example the bonding between the sunflower seed husks and the plastic, the flowability of the sunflower seed husks/plastic mixture, fire protection, coloring and, particularly for food or drink applications, resistance to oil, to UV, and to pests.

Particular preference is given to a mixture of 50% of PP (polypropylene), PE (polyethylene), or ABS (acrylonitrile-butadiene-styrene) on the one hand and, on the other hand, 50% of sunflower seed husks. This type of mixture therefore uses on the one hand a fraction made of PP and on the other

hand a fraction made of (ground) sunflower seed husks (sunflower shells) in the same quantity, where the sunflower shells have the properties described in the present application in respect of grain size, water content, oil content, etc. thereof. It is also possible to use PVC (polyvinyl chloride) or PS (polystyrene) or PLA (polylactide) instead of the plastics described, such as PP, PE, or ABS. The processing temperature is then sometimes determined by the plastics component if the maximum processing temperature thereof is below that of the shell material.

The inventive sunflower-plastic composite (SPC) here can be processed by a process which is already well established in plastics production. Particular preference is given to processing by means of injection molding, but it is also entirely conceivable and possible that any other type of plastics processing is used.

In the case of injection molding, the material, i.e. the mixed material composed of plastic on the one hand and of comminuted or ground sunflower seed husks on the other hand has to be homogeneous and amenable to problem free metering, in order that the entire melt has good flowability.

A desirable grain size of the sunflower seed husk material is therefore from 0.05 mm to 2 mm, preferably less than 1 mm. A particularly advantageous grain size of the sunflower shells (of the sunflower seed husk material) is from 0.01 to 0.5 mm, particularly preferably from 0.1 to 0.3 mm, and compliance with this grain size can also be achieved where necessary in that most of the husk material, e.g. 90%, is within the abovementioned range, and from 10 to 20% is outside of said range (by virtue of tolerance inaccuracies).

It is preferable that the sunflower seed husk material has a high level of dryness, i.e. that the water content thereof is from 1 to 9%, preferably from 4 to 8%.

The husk material (shell material) can also have fat content which is up to 6%, preferably at most 4% or less. Because of the geometry of the sunflower seed husks, and because of low impact resistance, the wall thicknesses are designed to be thicker in the injection-molding process than when plastics pellets are used alone. The substantially higher heat distortion temperature is advantageous, and provides stiffness to the composition at higher temperatures. SPC moldings can therefore be demolded at higher temperatures.

The invention is particularly suitable for use of an SPC for the production of packaging, preferably of food packaging, for example a jar, a bottle, or the like. This type of packaging can also if necessary be provided with an internal and/or external coating, in order to render the entire packaging more robust, and in order to exclude any possible sensory effect on the packaged material, such as oil or drinks, etc., due to the packaging material, i.e. the SPC.

In the present application, the use of sunflower seed husks/sunflower seed shells is the preferred use of a husk for the production of a "bioplastic composite".

The invention can also use, instead of sunflower seed husks or shells of sunflower seeds, other shells and, respectively, husks of other fruits, for example of nuts (in particular hazelnuts, walnuts, brazil nuts, beechmast, acorns) or of cereals, in particular rye, wheat, oats, triticale, barley, maize, rice, millet, or the like.

As already mentioned, it is already known that wood or wood fibers and the like can be used as compound material for natural-fiber-reinforced polymers, in order to produce a wood-plastic compound material which is then subsequently further processed. During the further processing here, the compound material is melted or in any event greatly heated, in order to render it flowable and therefore processable. However, in the case of wood-plastic composite materials this is very problematic when a temperature of 200° C. is reached, since in the temperature range starting at 200° C. the thermal stress to which the wood is exposed is excessive, and the entire material suffers from the resultant adverse effect. However, the polymers, i.e. polymer matrices such as polyethylene (PE), polypropylene (PP), polystyrene (PS), or polyvinyl chloride (PVC), have properties such as creep behavior and low heat distortion temperature which make them unsuitable for most structural applications unless they can be processed at high temperatures, namely at temperatures markedly above 200° C., for example in injection molding or the like. Load-bearing elements made of wood-plastic composite material also have to have significantly better mechanical properties than PP- or PE-based wood-plastic composite (WPC).

As mentioned, the use of high-performance plastics as matrix is subject to very severe restriction from the prescribed melting point (up to 200° C.). Added to this, engineering polymers that might be considered have very high prices which are unlikely to be economically viable.

Tests have now shown that processing temperatures achievable with the SPC biomaterial of the invention extend as far as 300° C., and that processing in the range from 220° C. to 250° C. is never associated with any degradation of the material, and that it is also possible to offer significant improvements in mechanical properties at an acceptable price.

The biomaterial or biocomposite of the invention, using sunflower seed shells/husks, can be used with excellent results for plastics parts in the automotive sector, films, and also carrier bags, packaging, industrial products and consumer products, decking, and furniture. Examples of possible uses in the automotive sector are shells of wheelhousings (known as wheel arches), the engine cover and also the underbody cladding. In the sector of films and carrier bags, particular mention may be made of the use of the biomaterial of the invention for the production of silo films, packaging films and carrier bags, and in the packaging and containers sector particular mention may be made in the invention of the production of food-and-drink packaging, trash containers, and plastics jars, and corresponding containers. Another particular possible inventive use of the biomaterial of the invention is the production of drinks crates, breadboxes, and plant pots, and also the production of portable equipment for the household and garden sector, for example chairs, benches, tables, and also of decking and doors.

Finally, it has been found that the impact resistance of the biomaterial of the invention can be adjusted in a desired manner by varying, on the one hand, the flower content of the sunflower seed shell material and/or, on the other hand, the grain size thereof.

As mentioned, the biomaterial of the invention or the biocomposite of the invention comprises sunflower seed shells/husks, and the biomaterial of the invention or the biocomposite of the invention therefore comprises sunflower seed shells/husks as base material. Where the expression sunflower seed husk material is used in the present application, this means the same as sunflower shells, sunflower seed shells, and sunflower husks. The material involved is always the shell material of sunflower seeds.

If, after the shell material has been separated from the seed, i.e. after shelling, the parameters of the material in respect of water content, grain size, or fat content, differ from what is used with particular advantage according to the present application, the material is correspondingly treated and processed. If by way of example the shell material has a water content of 15%, said water content is reduced specifically by drying to the desired value. If the shell material after shelling has a grain size that is too high, the desired grain size is achieved by subsequent grinding. If the shell material after shelling has excessive fat content, the fat content in the shells is specifically reduced by a conventional fat absorption process (also achievable by heat treatment).

Typical compositions of a biomaterial are mentioned below, and on the one hand comply with desired technical properties, and on the other hand are markedly more advantageous than previous (bio)plastics.

1. Embodiment: "ABS 300" Bioplastic

520 kg of PP (polypropylene), 300 kg of shells, 30 kg of additive (odor), 30 kg of additive (impact resistance), 30 kg of additive (moisture), 30 kg of additive (flow property), 30 kg of additive (adhesion promoter), 30 kg of additive (stripping agent).

A mixture of said material is then introduced in the usual way to a compounding process in such a way that the desired plastic in the desired form can then be produced from the compounded material, an example being extrusion or injection molding or rotomolding or press techniques or thermoforming processes.

An example of the suitable adhesion promoter additive is the product "SCONA TPPP 8112 FA" (adhesion modifier for polypropylene-natural-fiber compounds and in TPES compounds) from BYK, Additives & Instruments, Technical Data Sheet, Issue July 2011, a product from, and a company of, the ALTANA group. The Technical Data Sheet for this product is listed as table 1.

A suitable stripping agent additive is the product "BYK-P 4200" (stripping agent for reducing odor and VOC emissions in thermoplastic compounds), Data Sheet X506, Issue March 2010, from BYK Additives & Instruments, a company of the ALTANA group. The Data Sheet for the product is attached as table 2.

A product that appears to be particularly suitable as additive to counter odor generation is "Ciba IRGANOX 1076" (phenolic primary antioxidant for processing and long-term thermal stabilization), a product from Ciba. The Data Sheet for this product is attached as table 3.

Another additive suitable for process stabilization is the product "Ciba IRGAFOS 168" (processing stabilizer) from Ciba. A description of this product is attached as table 4.

A particularly suitable polypropylene material is the product "Moplen EP300K-PP-Lyondell Basell Industries". A Data Sheet for this product is attached as table 5.

Another composition (2^{nd} embodiment) of a different biomaterial with the in-house name "PP 50" is as follows:

45% of Moplen EP300K PP pellets
50% of sunflower shells
Irgafos 168, powder, 0.20%
Irganox 1076, powder, 0.30%
BYK P 4200, 2.00%
Scona TPPP 8112 FA, powder, 2.5%

The abovementioned constituents are compounded in the usual way, and can then be processed for the production of the desired plastics product of the present application in processes described, e.g. extrusion, injection molding, thermoforming, rotomolding, press techniques.

When the term compounding is used in the present application, it means the plastics-compounding process to which the biomaterial or bioplastic of the invention is subjected, and this means specifically the value-added process which describes the specific optimization of the property profiles of the biomaterial of the invention through admixture of additional substances (fillers, additives, etc.). The compounding process takes place by way of example in an extruder (e.g. a twin-screw extruder, but it is also possible to use a contrarotating twin-screw extruder or else a planetary-gear extruder and co-kneader for this purpose) and comprises inter alia the process operations of conveying, melting, dispersion, mixing, devolatilizing, and compression.

The purpose of the compounding process is to provide, from a raw plastics material, a plastics molding composition with the best-possible properties for processing and use. The objects of the compounding process here are to change the particle size, to incorporate additives, and to remove undesired constituents.

The compounding process finally produces an outgoing biomaterial which comprises the individual outgoing constituents, i.e. shell material, polypropylene, additives, etc., and specifically in mixed form. The compounded biomaterial product is generally produced in the form of intermediate product taking the form of a pellet or the like, in such a way that it can then be further processed in a plastics-processing machine to produce the desired plastics product, e.g. in an injection-molding machine.

By means of the invention it is possible to combine a byproduct of sunflower processing with plastic and thus, in a manner that conserves resources and is sustainable, to achieve a reduction of from 30% to 70% in the dependency of plastics production on petroleum.

Associated with this is the very favorable effect that the processing of the biocomposite or biomaterial of the invention also has on the CO_2 cycle, and also on the life cycle assessment of the products produced therefrom.

By means of the invention it is also possible to achieve the processing of the biomaterial of the invention—which can also be called biopolymer—at up to 300° C. (this having been found in initial tests) and to provide a novel biomaterial (biopolymer) with significantly improved mechanical properties at an acceptable price.

The biomaterial (biopolymer) of the invention can in particular be used in all product segments, and existing tooling can be used without difficulty for processing here.

The aim of the invention, to develop a biomaterial (biopolymer) which has a very high level of biofill and which nevertheless can be processed without difficulty in the form of industrial bioplastic, has been convincingly achieved. Finally, it is also possible, instead of the plastics described (PP, PE, ABS, PVC (polyvinyl chloride), PS (polystyrene)), to admix, or compound, a polylactide (polylactic acid) (abbreviated to PLA) with the plastics shells (the flour from these). The biological content of the entire plastic is thus again increased. PLA plastics per se are already known and are generally composed of many lactic acid molecules chemically bonded to one another, and are members of the polyester class. Polylactide (PLA) plastics are biocompatible.

The biomaterial of the invention can be used for the production of very different types of products, for example for the production of packaging (food packaging), of an automobile part (e.g. cladding for the wheelhousing), for portable equipment (tables, chairs, benches), decking, or doors, and the like. The biomaterial of the invention can also be used to produce baskets or containers, in particular those used in the food industry.

Below: Tables 1, 2, 3, 4 and 5.

TABLE 1

BYK Additives & Instruments Technical Data Sheet Issue July 2011			
SCONA TPPP 8112 FA			
Adhesion modifier for polypropylene-natural-fiber compounds and in TPES compounds Chemical structure			
SCONA TPPP 8112 FA	Polypropylene, highly functionalized with maleic anhydride		
Properties			
	Melt index in g/10 min (MFI 190° C., 2.16 kg)	Loss on drying in % 3 h/110° C.	MA content in %
SCONA TPPP 8112 FA	>80	<0.5	1.4
The values stated are typical, but do not represent a specification. Recommended addition quantities			
	Addition quantity in % of supply form, based on entire formulation		
SCONA TPPP 8112 FA	From 0.8 to 3, dependent on natural fiber content and on PP content in TPES compound		
Incorporation and procedure			
Homogeneous dispersion of the modifier in the compound Application sectors			
SCONA TPPP 8112 FA	Coupling agent in polypropylene-natural-fiber compounds Adhesive modifier in TPES compounds		

TABLE 1-continued

BYK Additives & Instruments Technical Data Sheet Issue July 2011	
A member of ALTANA Properties and advantages	
SCONA TPPP 8112 FA	Good flow properties in highly filled TPES compounds Significant improvement in mechanical properties in polypropylene-natural-fiber compounds Reduction of water absorption in polypropylene-natural-fiber compounds Good suitability for masterbatch production
Notes	
Supply form: Powder Storage and transport	
SCONA TPPP 8112 FA	Storage temperature max. 35° C. Relative humidity <80% Avoid direct exposure to sunlight and avoid contact with water
BYK Kometra GmbH Value Park: Y 42 06258 Schkopau Germany Tel: +49 3461 4960-60 Fax: +49 3461 4960-70 Info@byk(dot)com www(dot)byk(dot)com/additives	ANTI-TERRA ®, ATEPAS ®, BYK ®, BYK ®-DYNWET ®, BYK ®-SILCLEAN ®, BYKANOL ®, BYKETOL ®, BYKJET ®, BYKOPLAST ®, BYKUMEN ®, DISPERBYK ®, DISPERPLAST ®, ISAROL ®, LACTIMON ®, NANOBYK ®, SCONA ®, SILBYK ® and VISCOBYK ® are registered trademarks of BYK-Chemie AQUACER ®, AQUAMAT ®, AQUATIX ®, CERACOL ®, CERAPAK ®, CERAFLOUR ®, CERAMAT ®, CERATIX ®, HORDAMER ® and MINERPOL ® are registered trademarks of BYK-Cera The information above is given to the best of our knowledge. Because of the multitude of formulations and conditions of production, operation and processing, the use of the product must be checked in relation to the specific conditions used by the processor, The information provided in this Data Sheet is not to be interpreted as assurance of any particular property; we bear no responsibility for use of the product outside of the application sectors recommended; no liability can be derived from the above - and this also applies to any patent infringement This Issue replaces all previous versions - printed in Germany

TABLE 2

BYK Additives & Instruments Data Sheet X506 Issue March 2010			
BYK-P 4200			
Stripping agent to reduce odor and VOC emissions in thermoplastic compounds Chemical structure			
BYK-P 4200	Aqueous solution of polymeric, surface-active substances adsorbed on a polypropylene carrier		
Properties			
	Melting point in ° C.	MVR in accordance with ISO 1133 $cm^3/10$ min	Bulk density kg/m^3
BYK-P 4200	160	25	370

The values stated are typical, but do not represent a specification.

TABLE 2-continued

BYK Additives & Instruments Data Sheet X506 Issue March 2010			
Recommended addition quantities			
	Additive quantity in % of supply form, based on entire formulation		
BYK-P 4200	From 0.5 to 2.0%		
Incorporation and procedure			
BYK-P 4200 should be added to the plastic during or prior to compounding process			
Application sectors			
	Polypropylene	Polyethylene	ABS
BYK-P 4200	■	■	□
■ particularly recommended application sector			
□ recommended application sector			
Function			
The effect of adding BYK-P 4200 is to reduce the level of compound constituents that cause odor and emissions, or even to remove these entirely, during vacuum devolatilization.			
A member of ALTANA			
Properties and advantages			
BYK-P 4200	Major reduction in level of odor and VOC emissions No adverse effect on mechanical and optical properties No additional capital expenditure necessary for plant extensions Easy to use		
Notes			
To achieve efficient performance of the additive, vacuum devolatilization using at least 100 mbar is recommended. Wherever possible, operations should use only one vent shortly before the end of the extruder.			
BYK-Chemie GmbH PO Box 10 02 45 46462 Wesel Germany Tel: +49 281 670-0 Fax: +49 281 65735 Info@byk(dot)com www(dot)byk(dot)com/additives	ANTI-TERRA ®, ATEPAS ®, BYK ®, BYK ®-DYNWET ®, BYK ®-SILCLEAN ®, BYKANOL ®, BYKETOL ®, BYKOPLAST ®, BYKUMEN ®, DISPERBYK ®, DISPERPLAST ®, ISAROL ®, LACTIMON ®, NANOBYK ®, SILBYK ® and VISCOBYK ® are registered trademarks of BYK-Chemie AQUACER ®, AQUAMAT ®, AQUATIX ®, CERACOL ®, CERAPAK ®, CERAFLOUR ®, CERAMAT ®, CERATIX ® and MINERPOL ® are registered trademarks of BYK-Cera LICOMER is a registered trademark of Clariant The information above is given to the best of our knowledge. Because of the multitude of formulations and conditions of production, operation and processing, the use of the product must be checked in relation to the specific conditions used by the processor. The information provided in this Data Sheet is not to be interpreted as assurance of any particular property; we bear no responsibility for use of the product outside of the application sectors recommended; no liability can be derived from the above - and this also applies to any patent infringement This Issue replaces all previous versions - printed in Germany		
Material Data Center	Datasheet Moplen EP300K		

TABLE 5

Home Imprint About
Material Data Center is a leading international information system for the plastics industry. Material Data Center offers a comprehensive plastics database, calculation tools, CAE interfaces, a literature database and an application database.
For more information about Material Data Center visit www(dot)materialdatacenter(dot)com
This is the free Material Data Center Datasheet of Moplen EP300K-PP-LyondellBasell Industries
Material Data Center offers the following functions for Moplen EP300K: unit conversion, PDF datasheet print, comparison with other plastics, snap fit calculation, beam deflection calculation
Check here, which other Moplen datasheets, application examples or technical articles are available in Material Data Center
Use the following short links to get directly to the properties of interest in this datasheet:

ISO Data	Value	Unit	Test Standard
Rheological properties			
Melt volume-flow rate (MVR)	5.4	cm^3/10 min	ISO 1133
Temperature	230	° C.	ISO 1133
Load	2.16	kg	ISO 1133
Melt flow index (MFI)	4	g/10 min	ISO 1133
MFI temperature	230	° C.	ISO 1133
MEI load	2.16	kg	ISO 1133
Mechanical properties			
Tensile Modulus	1200	MPa	ISO 527-1/-2
Yield stress	27	MPa	ISO 527-1/-2
Yield strain	7	%	ISO 527/-1/-2
Strain at break	50	%	ISO 527-1/-2
Charpy impact strength (+23° C.)	N	kJ/m^2	ISO 179/1eU
Charpy notched impact strength (+23° C.)	10.5	kJ/m^2	ISO 179/1eA
Ball indentation hardness	53	MPa	ISO 2039-1
Thermal properties			
Temp. of deflection under load (0.45 MPa)	75	° C.	ISO 75-1/-2
Vicat softening point (A)	150	° C.	ISO 306
Vicat softening point (50° C./h 50 N)	71	° C.	ISO 306
Other properties			
Density	900	kg/m^3	ISO 1183
Characteristics			
Processing			
Injection molding, other extrusion, thermoforming			
Special characteristics			
High impact/impact modified			
Features			
Impact copolymer			
Applications			
General purpose			
Regional availability			
Europe, Middle East/Africa			
Disclaimer			

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Additional information about this material, for example substance group, producer contact address, and also in some cases datasheets and application examples can be found at www(dot)materialdatacenter(dot)com. Some of the information is restricted to registered users.

On the Start page there is a link to free Registration.

While this invention has been described in conjunction with the specific embodiments outlined above, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth above are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the inventions as defined in the following claims.

What is claimed is:

1. A biomaterial or biocomposite comprising:
sunflower seed shells/husks; and
a plastics material;
wherein said sunflower seed shells/husks are separated from sunflower seed cores by a peeling process;
wherein said sunflower seed shells/husks have a defined grain size, obtained by a milling process of the sunflower seed shells/husks, ranging from 0.01 to 0.5 mm; and
wherein a fat content of the sunflower seed shells/husks is up to 6% of the total sunflower seed shells/husks mass.

2. The biomaterial or biocomposite of claim **1**;
where the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 40 to 90% of the total biomaterial or biocomposite mass.

3. The biomaterial or biocomposite of claim **2**;
wherein the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 50 to 70% of the total biomaterial or biocomposite mass.

4. The biomaterial or biocomposite of claim **1**;
wherein the water content of the sunflower shells/husks is from 1 to 10% of the total biomaterial or biocomposite mass.

5. The biomaterial or biocomposite of claim **4**;
wherein the water content of the sunflower shells/husks is from 4 to 8% of the total biomaterial or biocomposite mass.

6. The biomaterial or biocomposite of claim **5**;
wherein the water content of the sunflower shells/husks is from 5 to 7% of the total biomaterial or biocomposite mass.

7. The biomaterial or biocomposite of claim **1**;
wherein the plastics material selected from the group consisting of:
polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), ABS (acrylonitrile butadiene styrene), PLA (polylactic acid), and PS (polystyrene).

8. A process for the production of the biomaterial or biocomposite of claim **1**, comprising:
processing sunflower seed shells/husks, by means of one or more methods selected from the group consisting of:
extrusion molding, injection molding, rotomolding, press techniques, and thermoforming processes; and
along with the processed sunflower seed shells/husks, utilizing a plastics material to produce the biomaterial

or biocomposite, the plastics material comprising one or more compounds selected from the group consisting of:

polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), ABS, PLA, and PS (polystyrene).

9. The process for the production of the biomaterial or biocomposite according to claim **8**;

wherein the sunflower seed shells/husks material is at least compounded with the plastics material; and

wherein, to produce the biomaterial or biocomposite, the compounded material is processed by means of one or more methods selected from the group consisting of:

extrusion molding, injection molding, rotomolding, press techniques, and thermoforming processes.

10. A product comprising:

the biomaterial or biocomposite of claim **1**.

11. The product of claim **10**;

wherein the product is selected from the group consisting of food packaging, an item of furniture, a door, decking, and an automobile part.

12. The product of claim **11**;

wherein the food packaging product is a jar or bottle.

13. The biomaterial or biocomposite of claim **1**;

wherein the grain size of the sunflower shells/husks ranges from 0.1 to 0.3 mm.

14. The biomaterial or biocomposite of claim **1**;

wherein the fat content of the shells is at most 4% of the total biomaterial or biocomposite mass.

15. The biomaterial or biocomposite of claim **14**;

wherein the fat content of the shells is from 1 to 2% of the total biomaterial or biocomposite mass.

16. The biomaterial or biocomposite of claim **1**;

wherein at least 80% by mass of all of the sunflower seed shells/husks in the biomaterial or biocomposite have defined grain size ranging from 0.01 to 0.5 mm.

17. The biomaterial or biocomposite of claim **1**;

wherein a fat content of the biomaterial or biocomposite is 6% or less of the total biomaterial or biocomposite mass.

18. The biomaterial or biocomposite of claim **1**;

where the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 30 to 90% of the total biomaterial or biocomposite mass.

19. A biomaterial or biocomposite comprising:

sunflower seed shells/husks; and

a plastics material selected from the group consisting of:

polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), ABS (acrylonitrile butadiene styrene), PLA (polylactic acid), and PS (polystyrene);

wherein said sunflower seed shells/husks are separated from sunflower seed cores by a peeling process;

wherein at least 80% by mass of all of the sunflower seed shells/husks in the biomaterial or biocomposite have defined grain size, obtained by a milling process of the sunflower seed shells/husks, ranging from 0.01 to 0.5 mm; and

wherein a fat content of the sunflower seed shells/husks is up to 6% by mass; and

wherein a fat content of the biomaterial or biocomposite is 6% or less of the total biomaterial or biocomposite mass.

20. The biomaterial or biocomposite of claim **19**;

where the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 30 to 90% of the total biomaterial or biocomposite mass.

21. A biomaterial or biocomposite comprising:

sunflower seed shells/husks;

wherein said sunflower seed shells/husks are separated from sunflower seed cores by a peeling process;

wherein said sunflower seed shells/husks have a defined grain size, obtained by a milling process of the sunflower seed shells/husks, ranging from 0.01 to 0.5 mm;

wherein a fat content of the sunflower seed shells/husks is up to 6% of the total sunflower seed shells/husks mass; and

where the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 30 to 90% of the total biomaterial or biocomposite mass.

22. The biomaterial or biocomposite of claim **21**;

where the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 40 to 90% of the total biomaterial or biocomposite mass.

23. The biomaterial or biocomposite of claim **22**;

wherein the proportion of the sunflower seed shells/husks in the biomaterial or biocomposite is from 50 to 70% of the total biomaterial or biocomposite mass.

24. A product comprising:

the biomaterial or biocomposite of claim **22**.

25. The product of claim **24**;

wherein the product is selected from the group consisting of food packaging, an item of furniture, a door, decking, and an automobile part.

26. The product of claim **25**;

wherein the food packaging product is a jar or bottle.

27. The biomaterial or biocomposite of claim **21**;

wherein the biomaterial or biocomposite comprises an SPC (sunflower-plastic composite) comprising:

the sunflower seed shells/husks; and

a plastic material.

28. The biomaterial or biocomposite of claim **21**;

wherein the water content of the sunflower shells/husks is from 1 to 10% of the total biomaterial or biocomposite mass.

29. The biomaterial or biocomposite of claim **28**;

wherein the water content of the sunflower shells/husks is from 4 to 8% of the total biomaterial or biocomposite mass.

30. The biomaterial or biocomposite of claim **29**;

wherein the water content of the sunflower shells/husks is from 5 to 7% of the total biomaterial or biocomposite mass.

31. The biomaterial or biocomposite of claim **21**;

wherein the sunflower shells/husks have been compounded with a plastics material selected from the group consisting of:

polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), ABS (acrylonitrile butadiene styrene), PLA (polylactic acid), and PS (polystyrene).

32. The biomaterial or biocomposite of claim **21**;

wherein the grain size of the sunflower shells/husks ranges from 0.1 to 0.3 mm.

33. The biomaterial or biocomposite of claim **21**;

wherein the fat content of the shells is at most 4% of the total biomaterial or biocomposite mass.

34. The biomaterial or biocomposite of claim **33**;

wherein the fat content of the shells is from 1 to 2% of the total biomaterial or biocomposite mass.

35. The biomaterial or biocomposite of claim **21**;

wherein at least 80% by mass of all of the sunflower seed shells/husks in the biomaterial or biocomposite have defined grain size ranging from 0.01 to 0.5 mm.

36. The biomaterial or biocomposite of claim **21**; wherein a fat content of the biomaterial or biocomposite is 6% or less of the total biomaterial or biocomposite mass.

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